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ABSTRACT

The correlation between individual level tones and vowel duration in Standard Thai was investigated. The study was prompted by the discrepancy between Gandour's 1977 claim that the pitch value of the three relatively level tones in Thai is negatively correlated with vowel duration and Roberson's 1982 disagreement with this hypothesis. The result of the present study supports Roberson; i.e., there is no correlation of the three level tones or vocalic nuclei and corresponding vowel duration values. It is suggested that Gandour's hypothesis may be supported, however, based on data available to him from various Thai dialects. Further study is recommended, particularly to determine whether there is any systematic correlation between a specific pitch (one specific short or long vowel) and vowel duration. Contains 14 references. (LB)

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CORRELATIONS BETWEEN THE THREE LEVEL TONES AND VOWEL DURATIONS IN STANDARD THAI

Sujaritlak Deepadung

Abstract: The purpose of this study is to investigate the correlation between individual level tones and vowel duration in Standard Thai. Gandour (1977:60) states that the pitch value of the three relatively level tones in Thai is negatively correlated with vowel duration, but Roberson (1982: 136) refutes this hypothesis. The result of this study agrees with Roberson, i.e., there is no correlation of the three level tones or vocalic nuclei and corresponding vowel duration values in Standard Thai.

Introduction

Background

The language studied in this paper is Standard Thai. In general, "Siamese" is remembered only by people over 50. Standard Thai is the national language of Thailand and the dialect spoken in the central region, including the capital of Bangkok. There are other Thai dialects in the rest of the country, but Standard Thai is used in educational, official, and business activities.

Scope of the Study

The purpose of this study is to investigate the correlation between individual level tones and vowel duration in Standard Thai. It is carried out as further research of what Roberson (1982:vi) stated:

> Contrary to what Gandour (1974a) suggested, this study did not find pitch values for the three relatively level tones to be negatively correlated with vowel duration; it is suggested that future research be directed towards individual level tones and vowel duration.

In Roberson's Abstract (1982:vi) he refers to Gandour's article (1974a), named "Consonant Types and Tones in Siamese" published in UCLA Working Papers in Phonetics, No. 27, and in Journal of Phonetics, No. 2, 1974. The original suggestion is, in fact, found in Gandour's article in 1977, "On the Interaction between Tone and Vowel Length: Evidence from

Kansas Working Papers in Linguistics. Vol. 13, 1988. pp. 17-31.

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Thai Dialects" published in Phonetica, No. 34, 1977 (Roberson 1982:11).

Gandour (1977:60) stated,

> Other factors being equal, (a) vowels (syllables) on low tones are longer than those on high tones; (b) vowels (syllables) on rising tones are longer than those on falling tones, and (c) vowel (syllable) duration is inversely related to the approximate average fundamental frequency.

In his article, Gandour based his study on subjective findings using several Thai dialects, not on systematic data designs for the Standard Thai language or on any acoustic experiments. As Gandour mentioned,

> The available auditory and acoustic data in the linguistic literature concerning the influence of tones on the duration of tone-bearing units indicate that the duration of a vowel (or syllable) is differentially affected by the shape of the tone. (p. 60)

In the present study, I begin with a description of tones and vowel durations in Standard Thai. Then the procedure and results are presented. Discussion and further research are in the last section.

Transcription

The following charts include all symbols used in transcribing the data in this study.

Consonants

	Bilabial	Labio-dental	Dental	Palatal	Velar	Glottal
Stops						
vd unasp.	b		d			
vl. unasp.	p		t	c	k	ʔ
vl. asp	ph		th	ch	kh	
Fricatives						
vl.		f	s			h
Nasals	m		n		ŋ	
Liquids			r, l			
Semi-Vowels	w			y		

Only the following consonants occur as final consonants:

-p	-m	-ʔ
-t	-n	-w
-k	-ŋ	-y

Vowels

	Front	Central	Back
High	i, ii	ɨ, ɨɨ	u, uu
Mid	e, ee	ɤ, ɤɤ	o, oo
Low	ɛ, ɛɛ	a, aa	ɔ, ɔɔ

Short vowels are written with one symbol, and their long counterparts are written with the same but double symbols. There are three diphthongs in the language.

Diphthongs

The three diphthongs in Thai are [ia, ɨa, ua].

Tones

There are the following five tones in Standard Thai:

Mid	unmarked
Low	ˋ
Falling	ˆ
High	ˊ
Rising	ˇ

Tones in Standard Thai

Standard Thai is usually analyzed as having the five contrastive tones of mid, low, falling, high, and rising. Tone is a property of the voiced segments of the syllable, and since the native Thai vocabulary is monosyllabic, tones can be referred to as lexical tones. Thai also has polysyllabic words derived from a compounding process.

The five tones can be divided into two groups, the dynamic tones and the static tones (Abramson 1962). Dynamic tones are characterized by the rather sharp downward F_o movement of the falling tone and upward F_o movement of the rising tone. The static tones are characterized by the relatively smooth F_o configuration. According to Abramson 1978 (126-7):

> We may conclude that fundamental-frequency levels do carry much information on the static tones, although they improve with movement. For the dynamic tones, as exemplified here by the rising tone, a rather abrupt movement is required. . . . Although the dichotomy between static and dynamic tones is imprecise and unstable, more so in production (Abramson, 1975) than perception, it is still useful as a rough classification of tone production and as an index to the types of acoustic cues used in recognition of tones.

Spectographic measurements of fundamental frequencies studied by Abramson on citation forms of monosyllabic words in 1962 show that the mid tone starts near the middle of the speaker's voice range and remains level; if it occurs before a pause, it drops slightly at the end. The low tone starts just below the middle of the voice range, drops gradually, and levels off somewhat above the bottom of the range. The falling tone starts rather high and drops rapidly to the bottom of the range. The high tone starts above the middle and rises slowly before a pause; in certain phonetic environments it drops slightly toward the end and shows somewhat laryngeal construction with irregular pulsing. The rising tone starts quite low and rises rapidly to the top of the voice range. (See Figure 1.)

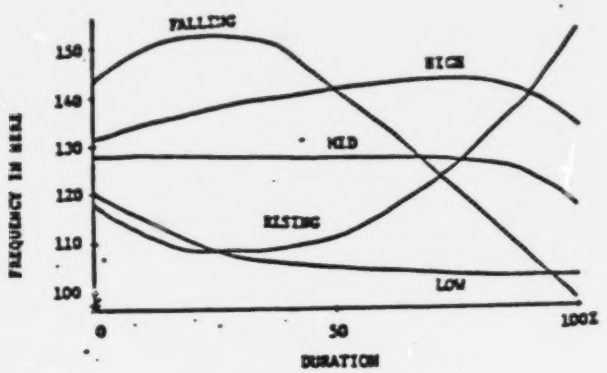

FIGURE 1. TONES ON DOUBLE VOWELS

Source: Abramson 1962:127.

Erickson (1974) also studied the shapes of the F_0 contours of the five tones of Standard Thai in utterance-final position. She found that they agree with those described by Abramson (1962). Gandour (1975) found that the contrast between all Thai tones is maintained, i.e., none of the tones neutralized, even in fast casual speech.

In principle, each tone can be part of any Thai syllable, with the following restrictions: single-vowel syllables ending in a stop have only high and low tones, and long-vowel syllables ending in a stop have only falling or low tones. Table 1 is a summary of the restrictions on the distribution of the five lexical tones ("+" indicates that the tone may occur on the syllable structure; "-" indicates that the tone may not occur).

Syllabic Structure	Tone				
	Mid	Low	Falling	High	Rising
CVV	+	+	+	+	+
CV(V)N	+	+	+	+	+
CV(V)G	+	+	+	+	+
CVS	-	+	-	+	-
CV?	-	+	-	+	-
CVVS	-	+	+	-	-

N = m n ŋ
S = p t k
G = w y

TABLE 1

RESTRICTIONS ON THE DISTRIBUTION OF THE FIVE LEXICAL TONES

Vowel Duration in Standard Thai

In Standard Thai there are nine vocalic phonemes that occur as single vowels and double vowels. Double vowels consist of geminates and vocalic clusters. The geminate vowels are longer than their single counterparts in a given context, and this vowel length is a distinctive feature of Thai. One of the studies concerning this is Abramson (1974: 76). He found that the ratio between corresponding long and short vowels of citation form is 2.5. (See Table 2.)

	V	VV
Number	14	14
Averages in msec	87	215
Ranges in msec	60-150	160-330
VV/V ratio	2.5	

TABLE 2

DURATIONS OF VOWELS IN MINIMAL PAIRS IN A CARRIER SENTENCE

According to Abramson, this ratio is also maintained in running speech, but the ranges of duration overlap by 10 msec.

My own study is described in the following section.

Procedure

The data selected for investigation consist of 30 tokens of $C_1V(V)^TC_2$ syllable structure.

V segments are [i:ii, a:aa, and u:uu]. T segments are (1) mid-level (not marked), (2) low-level (ˋ), (3) high-level (ˊ). C_1 segments are [p, c, s], and C_2 segments are [n, p, t, k].

The list contains 30 tokens. All are placed in utterance-medial position in the frame.

phûut kham wâa_____daŋ daŋ ná̀y
say word that_____loud loud Final particle
"Say the word_____louder."

Because of their placement within the frame sentence, all words in the blank receive stress. The vowels [i:ii, a:aa, and u:uu] are arbitrarily chosen as representatives of the Thai vowel system.

The initial consonants [p, c, s] and final consonants [p, t, k] are chosen on the assumption that they will create the least problem in measurement. Despite the fact that [n] may create problems of measurement, it is chosen in order that the minimal pairs of short and long vowels can receive the three level tones according to the restrictions of tonal distributions in Thai.

Some syllables used in this study have meaning and actually occur in the language. The reading list was arranged in random order. The words were written in the Standard Thai alphabet, which indicates tonal differences. The groups of words used are listed in Table 3.

The reading lists were read by four native speakers of Standard Thai, two men (A and T) and two women (P and S). The speakers were told to read the list at their normal speed. Each speaker read the list two times, except Speaker A, who read it three times. The recording was made in one session under language-laboratory conditions. Then wide-band spectrograms were made from the first recording of all the reading-list items except for some problematic readings.

The measurement points of vowel durations are as follows. If a syllable initial consonant is a stop [p], the starting point of measurement is made shortly after the release of the stop. If the initial consonant is an affricate [c] or a fricative [s], it is made on the voicing onset of vowels. The ending point of measurement is made on the voicing offsets

i:ii	
pin	Philippines
pi̍in	to climb
pi̍n	a straight pin with rounded head
pi̍in	∅
pín	sound imitation
piin	sound imitation
cì̍p	to sip
ci̍ip	pleat, to pleat
cíp	small, tiny
ciip	Jeep
a:aa	
pan	to share, divided into shares
paan	birthmark
pàn	to spin
paàn	remie, flax
pán	∅
paán	∅
sàt	animal
saàt	to toss out, to splash
sát	to throw, to toss
saát	"Sarte"
u:uu	
pun	proper name
puun	lime
pùn	Japanese
puùn	∅
pún	sound imitation
puún	sound imitation
sùk	to be ripe
suùk	fruit
súk	to snuggle
suúk	∅

TABLE 3

DATA

of the vowels. Fortunately, the nasal final [n] does not create any problem in deciding the transitional point from vowel formant to syllable final nasal formant. Finally, all measurements are compared. All vowel duration data are given in milliseconds.

Results

As mentioned above, one hypothesis states that the pitch values of the three relatively level tones in Thai are negatively correlated with vowel duration. A later study refutes this hypothesis, i.e., it does not evidence strong negative correlation "between F_0 values obtained on vocalic nuclei of the three relatively level tones and corresponding vowel duration values." (Roberson 1982:136).

In Table 4, five columns of the data list and vowel durations of the four speakers are arranged in sets of pairs of short vowels of low and high tones and long vowels of low and high tones. The results are:

1. Except for speaker A and the areas in the boxes, all vowel durations of low tones are either shorter than or equal to those of the high tones.

2. For the measurements enclosed in boxes, the vowel durations of low tones are longer than those of the high tones.

3. Speaker A's vowel durations for the low tones are shorter than those of the high tones in syllables ending with the stops [p, t] but vice versa in syllables ending with nasal [n] for the vowels [i:ii, a:aa].

4. For the syllables with [u] of speaker A, the durations of low-tone syllables are either longer than or equal to those of the high tones.

Summarizing this study, one can say that there is no correlation between level tones in Thai and vowel durations for the same minimal pairs. If there is such a correlation, it tends to be due to characteristics of individual speakers.

The results of averaging in Table 5 confirm Roberson's study; that is, there is no negative correlation between high and low tones and vowel durations in Thai, but one may say that there are overall tendencies in favor of the hypothesis that durations of the high-tone vowel nuclei are longer than those of the low-tone vowel nuclei.

	A	T	P	S
cì̀p	100	70	95	95
pì̀n	125	80	120	135
cí̀p	130	80	100	120
pí̀n	110	100	150	150
cì̀ìp	200	205	205	240
pì̀ìn	280	235	220	260
cí̀ìp	230	220	215	260
pí̀ìn	215	240	220	290
sà̀t	125	105	120	125
pà̀n	145	125	140	155
sá̀t	140	130	130	160
pá̀n	125	145	140	180
sà̀àt	225	260	240	310
pà̀àn	260	250	250	300
sá̀àt	315	260	260	335
pá̀àn	260	270	240	350
sù̀k	135	80	130	140
pù̀n	140	100	110	140
sú̀k	110	100	130	140
pú̀n	110	110	150	145
sù̀ùk	240	230	260	295
pù̀ùn	225	260	230	280
sú̀ùk	200	215	200	295
pú̀ùn	225	240	215	300

TABLE 4

COMPARISON OF VOWEL DURATION OF LOW AND HIGH TONES
ON MINIMAL PAIRS OF SHORT VOWELS AND LONG VOWELS

	A		T		P		S	
	V(V)	V(V)	V(V)	V(V)	V(V)	V(V)	V(V)	V(V)
Number	12	12	12	12	12	12	12	12
Averages in msec.	183	181	167	176	177	179	206	227
Ranges in mesc.	100-280	110-315	70-260	80-270	95-260	100-260	95-310	120-350
V(V)/V(V) ratio	0.99		1.05		1.01		1.10	

TABLE 5

AVERAGES OF VOWEL DURATION OF LOW AND HIGH TONES ON MINIMAL PAIRS OF SHORT AND LONG VOWELS

In Table 6, five columns of the data list and the vowel durations of the four speakers are arranged in minimal sets of short vowels and long vowels with the three level tones. The duration comparison in this table does not yield anything systematic; that is, in this study there is no correlation between pitch on vocalic nuclei and corresponding vowel duration values for the minimal pairs.

The averages in Tables 7 and 8 support the results in Table 5; that is to say, there is no correlation between pitch on vocalic nuclei and corresponding vowel duration values for the minimal pairs.

	A	T	P	S
pin	110	100	115	120
pìn	125	110	110	145
pín	110	100	150	150
piin	200	230	190	260
pìin	280	235	220	260
píin	215	240	220	290
pan	140	130	140	160
pàn	145	125	140	155
pán	125	145	140	180
paan	240	275	270	310
pàan	260	250	260	300
páan	260	270	240	350
pun	130	110	110	145
pùn	140	100	110	140
pún	110	110	150	145
puun	250	265	225	265
pùun	225	260	230	280
púun	225	240	215	300

TABLE 6

COMPARISON OF MID TONES WITH HIGH AND LOW TONES
ON MINIMAL SETS OF SHORT AND LONG VOWELS

	A		T		P		S	
	V(V)	V̀(V)	V(V)	V̀(V)	V(V)	V̀(V)	V(V)	V̀(V)
Number	6	6	6	6	6	6	6	6
Averages in msec.	178	196	185	180	175	178	210	213
Ranges in msec.	110-250	125-280	100-275	100-260	110-270	110-260	120-310	140-300
V̀(V)/V(V) ratio	1.10		0.97		1.01		1.01	

TABLE 7

AVERAGES OF MID TONES AND LOW TONES ON MINIMAL PAIRS OF SHORT AND LONG VOWELS

	A		T		P		S	
	V(V)	V́(V)	V(V)	V́(V)	V(V)	V́(V)	V(V)	V́(V)
Number	6	6	6	6	6	6	6	6
Averages in msec.	178	174	185	184	175	186	210	236
Ranges in msec.	110-250	110-260	100-275	100-270	110-270	140-240	120-310	150-350
V́(V)/V(V) ratio	0.97		0.99		1.06		1.12	

TABLE 8

AVERAGES OF MID TONES AND HIGH TONES ON MINIMAL PAIRS OF SHORT AND LONG VOWELS

Discussion

Roberson's 1982 study aimed at an examination of tones (F_o patterns) of Bangkok Thai and the effects of rapid sentence context. He had six native Thai speakers read 96 real morphemes in phonetic isolation and in rapid sentences. He fully used the equipment and software necessary for acoustic measurements.

His findings about interaction between Bangkok Thai tones and vowel duration are: pitch tends to increase in a rapid sentence context, and corresponding vowel durations tend to decrease in a rapid sentence context; however, he found no systematic interaction between pitch and corresponding vowel durations.

The present study agrees with Roberson's study that there is no correlation of the three level tones or vocalic nuclei and corresponding vowel duration values in Standard Thai. But Gandour's hypothesis may be supportable based on data available to him from various Thai dialects.

Because the main objective of Roberson's study was to examine the F_o patterns of Bangkok Thai in isolation and in rapid sentence context and in male and female F_o patterns, he did not design his data for the study of correlations of duration of vowels and the three level tones. In this present study, which is specifically designed for such correlations, the two variables are not found to be either strongly positively or strongly negatively correlated.

However, the results of this study may not be absolute because many factors are involved: the experiment design, the amount of data, the number of speakers analyzed, the recording process and instructions, personal characteristics of each speaker (for example, speaker P did not speak with maximum volume), the accuracy of measurements, and my lack of statistical knowledge.

With all these factors in mind, further study on this subject is suggested. One specific short or long vowel in various environments should be used to see whether there is any systematic correlation between that specific pitch and vowel duration. Further, any correlations between that vowel with the three level tones could be studied. Finally, such correlations of individual vowels in the language studied could be examined.

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